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PAPERS

IN

MECHANICS.

No. I.

METHOD OF CONCENTRATING A SHIP'S BROADSIDE.

The **GOLD ISIS MEDAL** *was voted to Mr. W.* **KENNISH,** *of Chatham, Gunner in the Navy, for his method of Concentrating the Fire of a Ship's Broadside. Models in illustration of the same have been placed in the Society's Repository.*

THE line traced by a sweep from head to stern across the port-holes of a ship's gun-deck will represent an irregular curve or arc, of which a line drawn on the same deck, parallel with the keel, may be considered as the chord. It is, therefore, evident, that if the guns are trained each to form a right angle with the adjacent parts of such arc, all of them (except the two or three nearest the middle of the vessel) will throw their shot in lines diverging at various angles from a line drawn at right angles outwards from the keel, and consequently from the enemy. If, on the other hand, the guns are trained on lines converging towards a line passing outwards amidships, at right angles to the keel, and indefinitely prolonged, it is evident that the guns so trained will throw their shot converging towards the enemy, as is shewn in fig. 1, Plate II., 7 being the point of convergency or concentration.

The object of Mr. Kennish has been so to regulate the convergency of these lines, that at certain given distances all the shot from the broadside of a ship shall strike one spot, and consequently produce a greater effect in destroying the masts or breaking up the hull, than if the shot were equally distributed over the whole surface of an enemy's ship.

To do this, two things are necessary; first, to be able to train the guns so that their shot shall fall together at certain distances; and secondly, to be able to ascertain correctly when an enemy's ship is within such distances.

The first of these conditions is effected in the following manner. In frigates, or vessels with only one tier of guns, one of the guns amidships is to be levelled truly horizontal, by means of the quoin at the breech of the gun and the gunner's quadrant; a spar, as high as the ship's bulwark, is to be erected perpendicular in a boat, and is to be brought alongside close to the muzzle of the gun: the diameter of the bore of the gun's muzzle is to be marked on the spar, and called the bull's-eye. The boat is then to be removed two hundred yards from the ship's side, still remaining parallel to it; and at this time every gun, being first cast loose, is to be carefully trained so as to point on the bull's-eye, bearing at the same time on its own breast-piece. The common breast-piece is a triangular block of timber, fastened withinside the port, having the projecting angle pointing inwards. The breast-piece used by Mr. Kennish is of the same figure as that in common use, but is cut in two by a horizontal section, forming it into two equal and similar parts, of which the lower is fixed in the usual way, while the upper is placed in the reverse direction, and is enabled to traverse on the lower by means of a centre pin placed in a hole bored through the upper piece, at the point of the angle, and into the lower piece as shewn at 9, fig. 12. Fig. 13 is a vertical section through one of the ports, shewing the two parts of the breast-piece 8 and 10 in place, and the centre pin 9. When, therefore, a gun is brought to point on the bull's-eye, as before mentioned, the upper part of the breast-piece will make a certain angle with the lower part. While they are in this position, bore two holes 1 1, fig. 12, one on each side of the centre pin, through the upper and into the lower part of the breast-piece, so that the former may be kept in its position by means of a bolt dropped into each of the two holes: these bolts, one of which is shewn separate fig. 13, are attached by chains to the sides of the port. But the gun, besides being placed in a true horizontal position, must be placed in a true vertical one, which is done by driving the quoin more or less in, till the gun has got a proper elevation. The quoin being in this position, a line, numbered 1, is to be drawn on it, in continuation of one previously drawn on the bed of the carriage. All the guns in the tier being adjusted in the manner just described, it is evident that they may, at any time afterwards, be placed in the positions proper to allow their shot to converge at the distance of two hundred yards, by setting the movable breast-pieces to No. 1, then bringing the front of each carriage close up to its breast-piece, and setting its quoin to the mark No. 1 on the bed.

The boat carrying the spar is then to be moved to the distance of five hundred yards from the ship, and a line or bull's-eye is to be made on the spar, seven feet above the former one; the guns are then pointed on this second bull's-eye, and holes No. 2 are to be bored in the breast-pieces fig. 12, and lines No. 2 are to be drawn on the quoins, to indicate this second position of the gun.

The spar is next to be removed to the distance of eight hundred yards, a third bull's-eye having previously been marked on it fifteen feet above No. 1, and the breast-pieces and quoins are to be adjusted, as already described, to this third distance, the holes in the former and the lines on the latter being numbered respectively 3. The inventor does not consider his plan to be applicable with much precision to distances exceeding eight hundred yards.

In ships of two or more tiers of guns, a separate bull's-eye must be marked on the spar for each tier. For close quarters, that is, a distance not exceeding two hundred yards, the guns of all the tiers are pointed to one spot on the side of the enemy's ship, as shewn in fig. 2; but for the two farther distances of five hundred and eight hundred yards, the guns of each tier are pointed to a separate focus: there are, therefore, two or three spots, a little above each other, aimed at on the side of the enemy's ship, according as there are two or three tiers of guns in that to which Mr. Kennish's plan has been adapted. The respective distances above the level at which the bull's-eyes are to be marked on the spar, for the two upper gun-decks and at the two distances, are marked in the diagram fig. 3.

From what has been said, it is plain that, after the breast-pieces and quoins have been properly adjusted and marked, the guns may be so trained as to concentrate their shot at the distances of two hundred, five hundred, and eight hundred yards, with the greatest expedition and facility. But this is not all, for an instrument is still wanted to shew when the enemy is at a distance and in a position coinciding with one of the three points on which the shot become concentrated. Such an instrument forms the second part of Mr. Kennish's invention; and its construction and use will, it is hoped, be understood from the following description.

At *a*, in figs. 1, 2, and 3 (the former of which is a top view of a ship's broadside, and the two latter are sections near the middle guns of each tier), is placed an upright iron standard, part of which is shewn at *b b*, fig. 4, and at *b*, fig. 5, which is a top view. It is six feet high, and on it is fitted an arm *c c*, which may be set at any height on the standard by the binding screw *d*. On the arm *c c* slides another arm *e e*, figs. 4 and 5, with a binding screw whereby it may be fixed; and again on this latter slides the short arm *f*, figs. 5, 6, 7, from which the instrument is suspended. By the adjustment of these arms the instrument may be shifted a little to the right or left, or fore and aft, and yet be kept in the same direction. Fig. 4 shews the right-hand side of the instrument, with which the top view, fig. 5, corresponds. Fig. 6 is a front view, fig. 7 is the left side, and fig. 8 is a top view, partly in section.

On the arm *f* is fixed a horizontal dial or circular divided plate *g g* (in fig. 5 it is, by mistake, marked *y y*). Through this plate and the arm *f* rises an axis, on which the index *h* is secured by a screwed nut *i*, from which also the axis itself, and all the parts connected with it, are suspended. To the bottom of the axis is secured a swing frame, in which are inserted the two screws *j j*, between the points of which is held a cross-shaped bar *k*, figs. 4 and 7, attached at the lower end to the two circular frames *l l*, and to the vertical bars *m m* : the frames and bars, therefore, swing right and left on the screw-points, so as to keep the perpendicular in that direction; *n* is a stout transverse bar passing through both *l* and *m*, in order to connect them the more completely; *o o* are two opposite screws passing through their respective bars *m m*, and at right angles to the screws *j j*: between these is hung the iron tube *p p*, which, therefore, is capable of motion only in a direction at right angles to that of the circular frame by which it is suspended. That the tube may remain horizontal, or at any required vertical angle, a square bar *s s* is secured beneath and parallel to it by the knees *t t*: on this bar slides the top of a pendulum-rod *u u*, the transverse hole through the head of which is elongated by the socket *w w*, fig. 7, in order to prevent any oscillation of the pendulum. *v v* is a long adjusting screw, supported by the knees *t t*, and working in a screwed hole in the pendulum-rod; therefore the pendulum-rod may be made to traverse backward or forward on the bar *s s*, by turning the milled head *x* of the screw one way or the other, the effect of which will necessarily be a variation in the angular position of the tube *p p*; and as this tube is suspended between the two cross pairs of screws *o o* and *j j*, each pair allowing of motion at right angles to the other, the tube hangs in gimbals, and will keep the angular position given to it by the pendulum, unmoved by any rolling or pitching motion of the ship. At each end of the tube is a pair of cross-wires, fig. 9, the intersections of which coincide with the axis of the tube. *r* is a ring, or shallow cylinder, with a single wire across its diameter, as shewn in fig. 10: this ring is supported by two arms *q q*, fig. 8, which move on the same pivots or screw-points *o o*, figs. 4, 6, 7, as the tube *p p* does: the cross-wire, therefore, of this ring is capable of being brought to coincide with the intersections of the two pairs of cross-wires in the tube *p p*. The arm *q*, where it crosses the circular plate *l l*, fig. 7, is expanded into an arc, with a slit in the middle, by means of which the ring *r*, having been brought to coincide with the tube *p p*, may be fixed in this position by the binding screw *y*. The dial-plate *g g* (marked, by mistake, in fig. 5, *y y*) is fastened by a screw to the arm *f*, and is thus prevented from having any proper motion; but its index being fixed parallel to the axis of the tube *p p*, and having precisely the same horizontal circular motion as the tube, the position of this latter is shewn by that of the index on the graduated circle of the dial-plate.

Having now described separately the parts of the instrument, I proceed to shew how it is to be adjusted for use.

The height at which the instrument hangs depends on the height at which the horizontal bar *c* is fixed by means of its binding screw *d* on the upright iron standard *b*, fig. 5; and the capability of the bar *f* being slid on the bar *e*, and likewise of the bar *e* being slid on the bar *c*, allows of a horizontal adjustment of the instrument, so as to afford a clear view through the tube *p p*. These adjustments being made to suit the convenience of the observer, a line is drawn on *b*, another on *c*, and a third on *e*, coinciding with the respective positions of *f* on *e*, of *e* on *c*, and of *c* on *d*, so that the apparatus, after having been dismounted, may be put up again in precisely the same position as at first. When the boat carrying the bull's-eye has been removed from the ship's side to a distance of two hundred yards, and the breast-pieces and quoins of the guns have been adjusted, as already shewn, the ring *r* is to be raised out of the way, and secured in that position by the binding screw *y*, as shewn in fig. 7; the milled head *x* is to be turned round till by means of it the pendulum-rod has advanced on the screw *v* far enough to give such an angular position to the tube *p p*, that the intersections of its cross-wires shall exactly correspond with the water-line of the boat carrying the bull's-eye, as shewn at *u*, fig. 2. By turning the binding screw *z*, fig. 4, this position is secured, and a line indicating such position is to be made on the circle *l l*, and marked No. 1. The screw *y*, fig. 7, is now to be loosened, and the ring *r* is to be brought down till its cross-wire corresponds with the intersections of the cross-wires of the tube *p p*; a line indicating this position is then to be drawn on the right-hand side of the circle *l l*, fig. 4, and is to be marked No. 1. All the adjustments are now completed for a distance of two hundred yards. The adjustments for the respective distances of five hundred and eight hundred yards are made exactly in the same way as already described for the first distance; that is, the cross-wires of the tube are brought, by the action of the screw *v v* on the pendulum, to coincide with the water-line of the boat; and this position is to be marked on the left-hand side of the circle *l l*, fig. 4, while the corresponding position of the ring *r* is marked on the opposite side of the same circle.

In order to shew the method of using Mr. Kennish's apparatus, let it be supposed that the captain of the ship chooses to engage his enemy at the distance of five hundred yards, or No. 2. The quoins and breast-pieces are accordingly adjusted to this number, as likewise is the angle of the tube *p p*, and of the ring *r*; an attentive officer is stationed at the tube, which he directs on the enemy's ship, and continues giving orders to the helmsman till his own ship is brought into such a position that the cross-wires of the tube *p p* bear on the water-line of the enemy, and the index *h* on the horizontal dial-plate *y* points to the same division that it did when the primary adjustment was made. Nothing farther would now be requisite than to give the signal to fire, provided the ship itself were quite still; but as the swell of the sea will keep the ship and all other parts of the apparatus in constant motion, while the tube, being hung in gimbals, remains at the same angle (as shewn by the dotted lines, fig. 4), it follows, that the coincidence of the cross-wire of the ring *r* with the intersection of the two pairs of cross-wires in the tube *p p* is the only position in which the shot will strike the point seen through the tube *h h*. As soon, therefore, as this coincidence occurs, and which may often be only of a moment's duration, the officer gives the signal to fire by ringing a bell. Thus the whole broadside is discharged by the simultaneous execution of one order; and, if the previous adjustments have been carefully performed, it is hardly possible that a large majority of the shot should not fall within so small a space on the side of the enemy's ship as to produce very serious injury.

It appears that experiments on the efficacy of Mr. Kennish's plan were made in the year 1830, at Portsmouth, on board the Galatea, the adjustments being made by Mr. Kennish himself. Two broadsides were discharged, the first of ten guns, and the second of sixteen. Of the first broadside, seven shot struck a six-feet target, and nearly the whole of the second broadside, the target being entirely destroyed by it.

If at any time the captain of the ship chooses to have his guns worked separately in the usual way, he has only to reverse the position of the upper parts of the breast-pieces, and to secure them by dropping an iron pin into each of the two unmarked holes, as shewn at 8, fig. 12.

The method above described of concentrating a ship's broadside, may be employed with at least equal, and perhaps superior efficacy, against any fixed object ashore, such as a fort or battery.

No. II.

COMPOUND CAPSTAN.

The LARGE SILVER MEDAL *was presented to Mr. T.* MEDLEN, 23, *Gill Street, Limehouse, for a Compound Capstan; a Model of which has been placed in the Society's Repository.*

THE great merit of Mr. Medlen's capstan consists in the simplicity of its construction, its small liability to be injured, and the facility with which the two capstans of which it consists may be either completely detached, or combined so as to work in concert; the lower capstan, round which the rope passes, moving either at the same rate as the upper one, or five times as slow; in which case, the effective power of the machine is equal to six single capstans.

It is beginning to be adopted in the navy, one having been fitted on board the Maidstone frigate, and another on board the Rose sloop of war. It is, however, considered to be especially serviceable on board sheer-hulks; and accordingly one at Portsmouth is so employed; three also have been sent to Gibraltar, five to Malta, two to Bermuda, and two to Trincomalee, for dock-yard use at those naval stations.